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AUTHOR Knoppel, Curt; And Others
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ABSTRACT

The paper describes Miss STIM, an electronic teaching aid designed to increase the computer's educational potential for severely handicapped students. The aid incorporates both video images and audio signals and is programed to present lesson material in conjunction with responses from the student. System operation is described in terms of stimulus generators, student response recorders, video monitors, and computerized control devices. The student's physical responses are recorded on videotape for the instructor's use. The educational material is presented by means of disks performing three functions: coordination of different electronic components, control of audio/video images from the videodisc players to the monitors, and data storage for individual student files following completion of a lesson. Versatility of the unit is stressed, and new programs under development are described. Appended materials list the main computer program menus and sub-menus and briefly describe a series of educational materials scheduled for release in 1986-87. (CL)

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Miss STIM: An Extra-Interactive Electronic Learning System

Curt Knoppel, Betty Fried, and James H. Bargelt
ITX Labs
North Hollywood, CA

EC 191358

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Introduction

Educating the severely handicapped presents special challenges due to the student's reduced capacity to learn. With severe handicaps, such as autism, this task is compounded by both the presence of behavioral disorders and the need to begin the educational process on a very basic level. Recently, the use of computers in the classroom has helped increase the learning capacity for the handicapped population by repetitively presenting educational material, identifying and evaluating trends in the student's responses, and by remaining immune from fluctuations in emotional behavior.

Miss STIM (from stimulation) is an electronic teaching aid designed, by ITX Laboratories, Ltd., with the intention of increasing the computer's educational potential through the integration of commercially available technology. The electronic hardware has been assembled to provide Miss STIM with a "humanoid " personality. On the front of Miss STIM (Figure 1), two color monitors serve as the eyes while the lens of a hidden video camera serves as the nose. On the rear panel, there are two video disk players, a standard video cassette recorder, a computer keyboard, and a monitor for the teacher. Like a teacher, Miss STIM is highly mobile and can easily be moved throughout the classroom.

Miss STIM presents educational material called Stimware. The Stimware possesses both high resolution video images and audio signals on two laser videodiscs and is programmed to present lesson material in conjunction with the responses from the student. Further, Stimware offers versatility not found in other forms of instruction. The uses of this interactive videodisc technology create exciting new possibil-

ities for handicapped children that will be described in greater detail later.

System Operations

The hardware components for Miss STIM can be divided into four separate areas: stimulus generators, student response recorders, video monitors, and computerized control devices. A block diagram illustrating the relationships between these components is shown in Figure 2.

Prerecorded audio and video tutorials are stored on plastic laserdiscs and presented to the student using two videodisc players. After the signals travel through a specially designed electronic interface, they are presented to the student on two separate color monitors. Audio signals are presented using two loud speakers. The student watches the tutorial and responds by pressing keys on a specially designed keypad. Responses from the keypad are sent to a computer where their accuracy is evaluated and stored for later analysis. The instructor controls Miss STIM using a standard computer keyboard and a small monitor located on the rear panel. She can change the lesson tutorial by responding to a few simple instructions from the computer or store and print data using two disk drives and a dot matrix printer.

One advantage of Miss STIM is the full integration of sophisticated consumer technology. Miss STIM uses two interactive, computer controlled, videodisc players (Phillips VP 935). These devices store video images on a plastic disc (as opposed to the magnetic tape used with video cassette recorders). During operations, a low powered laser is directed against the disc and retrieves the previously recorded

audio and video images. Since the mechanical arm that contains the laser never actually comes in contact with the disc, the videodisc player is able to jump to different locations on the disc without encountering any mechanical interference (a complete sweep across the disc takes less than two seconds. The videodisc players used with Miss STIM can, by simply providing the computer with a few commands, scan forward, scan in reverse, jump to any section on the disc, advance through the lesson at an accelerated or decelerated pace, or freeze a single frame on the screen.

Three color monitors (Panasonic CT-1111D) are used with Miss STIM (two students, and one control monitor). Each monitor presents high resolution images from either the computer or videodisc player and feature easily accessible tint, contrast, brightness, and color controls. Using two monitors with the student provides Miss STIM with unique teaching capabilities. In one mode, two sets of video images can be presented on different monitors. One monitor could, for example, present a lesson tutorial while the second provides a visual reward for correct responses. In a second mode, a set of images from the videodisc player can be shown on one monitor while the child's own image, via the video camera and video cassette recorder, is seen on the second monitor. This feature is useful when the child is required to mimic specific physical actions that occur while learning sign language or speech/articulation training. The teacher's monitor is highly versatile and can be used to either view the program being presented, view the child via the video camera, or access the computer menus to control the lesson.

As stated earlier, the student's physical responses are recorded and stored on video tape to provide the instructor with the option of watching how the child reacts when presented with certain types of stimuli. A Magnavox (model VR2877BK) video camera is connected to a Magnavox (model VQLS903) video cassette recorder. The camera features a 35mm zoom lens, electronic viewfinder, and a built in omnidirectional condenser microphone. The video cassette recorder contains all of the standard features including tape advance, rewind, pause, and single frame viewing.

The unique nature of these instruments is how they are controlled by Miss STIM. During normal operation, while the student is responding, Miss STIM records the video information and time-codes the tape so the instructor can quickly locate and evaluate specific images. For example, if the instructor notices that a student consistently fails on a small number of stimuli, she can quickly review the child's behaviors by locating those recorded images which correspond to the specific set of responses. Further, the operations of the camera and video recorder are controlled by the computer.

The front panel of Miss STIM contains connecting ports for a keypad (or, when appropriate, a keyboard) that will be used by the student when responding. Keypads can be detached from Miss STIM and placed on a table in front of the student. Numerous keypad configurations are currently being developed by ITX Laboratories ranging from boards with four or five large multicolored buttons to a full scale computer keypad for typing text and numerical information. In the future, the keypads will light up the correct button when the student responds appropriately and provide vibrotactile feedback.

Two of the central components for Miss STIM's operations involve the computer and interface. Miss STIM's currently uses a Commodore 64 (C64) computer with 64 kilobytes of available storage space. The teacher's keyboard is the actual computer keys on the C64. During normal operation, the computer receives information from the student, via the student's keypad, and determines the accuracy of the response. This response is stored in memory while the computer instructs the videodisc players to present new information (or reintroduce the same information in a different manner).

The interface box serves as a switching network for all of the electronic components. It relays images from the videodisc players to the appropriate monitors and allows the instructor to immediately access any single piece of equipment and determine its operational status. Further, it contains a modem for telecommunication, a device for stamping the date and time onto the videotape, and the speech sampler to store and insert the student's name into the program at the appropriate moment. Later versions of Miss STIM will use a speech synthesizer to generate both the child's name and the audio signals within the program.

Three different computer peripherals are available with Miss STIM. Two INDUS GT disk drives are used to store individual student data on standard 5.25 inch floppy disks. The memory capacity for each disk is 166 kilobytes. An optional letter quality or dot matrix printer will be available for Miss STIM to provide hard copies of the student's responses for later reference.

A second integral component of Miss STIM is the Stimware. Stimware provides Miss STIM with the ability to present highly sophisticated educational material using the audio/visual signals stored on laser videodiscs. Specifically, the Stimware components provide Miss STIM with a simple personality and allow her to come "alive."

Stimware components are comprised of four separate disks (two video discs and two computer floppy disks). The computer disks contain programs which perform three distinct functions: (1) The coordination of different electronic components throughout the Miss STIM system, (2) the control of audio/video images from the video disc players to the two monitors, and (3) data storage for individual student files following the completion of a lesson.

Each of these three processes is complex. The instructor controls the videodisc players, monitors, video camera, and video cassette player using a simple menu-driven software program (Appendix 1). During this procedure, the instructor begins by selecting an item from the main menu which contains general system commands (eg. beginning a lesson, viewing a student file). Later, a command from a sub-menu allows the instructor to perform specific operations (ie. viewing the lesson in an accelerated mode). The process of controlling the software program has been simplified and typically involves pressing only one number on a computer keypad. If a problem within the Miss STIM system, or the instructor needs additional information about a specific command, then a friendly "Help" menu can be accessed by pressing one key.

The second process involves having the computer engage in the

intricate switching of audio/visual images between the two student monitors, along with the recording of the student's physical actions via the video camera and cassette recorder. Each Stimware tutorial involves the use of numerous audio and video segments. Since these tutorials are responsive to the student's actions, a computer program was designed to control the flow of information. In each tutorial, a series of commands specifies which section of the lesson will be presented, the order of presentation, how the audio and video images will be combined, and whether the child's name will be inserted into the sentence(s).

The third function involves storing a student's responses following the presentation of a lesson. Miss STIM provides each student with an individual storage disk. The storage disk can be embedded with the student's name, a student code number, and a password which prevents unwanted access. During the tutorial, Miss STIM automatically records the correct and incorrect responses. After the lesson is terminated, these responses are transferred on to the student's floppy disk along with the date, time, and lesson number. Later, when the instructor is interested in evaluating the student's performance, Miss STIM searches through the files and calculates the results for each lesson (or series of lessons).

The use of laserdisc technology provides Miss STIM with extraordinary versatility. A total of 54,000 video frames can be stored on one side of each disc. This storage capacity represents a total of one hour of material (assuming that the program runs in a linear progression). However, unlike other educational methods, an interactive videodisc player does not need to operate in this mode. Instead,

the videodisc players can search back through the tutorial to present same segments repeatedly to the student. Two separate segments can even be combined to form a completely new set of stimuli. In fact, the 54,000 frames can be combined to create an almost infinite number of stimulus combinations.

Other forms of technology lack this versatility. For example, if 200 frames are used to present a single concept to a student, and the concept needs to be repeated (which is common for handicapped students), the random access memory (RAM) capabilities used in interactive video technology enables the videodisc player to return to the beginning of the segment and repeat the same stimulus. Video cassette programs or film strips, require the storage of multiple sets of needless images on tape to perform this same operation. This occupies more space on the tape and increases the cost of designing the program.

Numerous Stimware programs are in the process of being designed for Miss STIM (Appendix 2). Each lesson is intended to present a comprehensive program in one major area that is impaired in communication/learning handicapped children. Other areas of application include employment training and medical rehabilitation. Already, educators are using (Slaton, 1985) laserdisc technology to teach foreign languages. In fact, the ability to program the presentation of the video images creates an almost limitless number of applications for this technology.

Prior to actually recording the lesson material, the entire topic is thoroughly researched and stimuli are arranged in a hierar-

chical order of complexity. Qualified specialists in the topic area are consulted and actively participate in designing the program. Later, a storyboard is constructed outlining all of the audio and video sequences. In some instances, standard learning programs for handicapped children are adapted and formatted for use with Miss STIM.

Figure 3 provides a sample flowchart outlining how information is presented during a typical Stimware program. A concept is presented in detail using both audio and visual stimuli. Following this first tutorial, the student is asked to respond using the keypad. If the response is correct, the student is rewarded and the next concept is presented. If the response is incorrect, the same information is presented in a second tutorial which has been modified to facilitate learning. Again, the student is tested and rewarded for a correct response. If the student fails again, a third, and final tutorial (a "super" tutorial) is presented. If the student fails at this level, Miss STIM terminates the program and notifies the instructor that the student needs tutorial assistance.

Both the main lessons and the second/third tutorials are constructed to insure that material flows smoothly between story segments without omitting important information. Further, the reward segments were carefully designed to be both fun and stimulating for the student. Typically, a reward will involve having one screen change color or begin flashing while the second monitor displays an object spinning around (such as a pinwheel).

The physical layout of the lesson material onto the laser disc varies considerably from the construction process used when

recording a regular analog record. Since the audio and video tracts change constantly during the tutorial, the stimuli need to be laid out in a sequence that minimizes the amount of time needed to jump between segments. During operation, the video disc player can jump from the beginning to the end of the program in less than two seconds. Regardless, during this brief period, the screen becomes inactive and the picture "freezes" (or goes blank) while new material is being located.

To keep the lesson progressing without interruptions, certain audio and video segments were physically located adjacent to each other. This helped reduce the amount of time needed for the video sequences to be located and accessed by the video disc player. In certain instances, it was decided to insert the student's name at the beginning of a statement (to help focus attention). Specific audio segments were recorded with spaces reserved for the student's name. The computer, at the beginning of the program, loads the name into memory and recalls it at the appropriate moment. At other times, only a portion of an audio segment is presented to the student while the remaining section of the signal is omitted. Later, when the program returns to the same segment of the program, the entire audio signal is presented to add a degree of diversification.

Conclusion

The use of interactive video technology will provide a new and significant contribution to the area of Special Education. Miss STIM utilizes this technology to serve as a dynamic teaching aid.

The hardware configuration contains numerous advantages including the use of cost effective, fully tested and commercially

available electronic components that are simple to operate. Importantly, each device is supported by its own warranty and service organization.

Much will depend on the forthcoming Stimware Tutorials. They have the potential to stimulate and hold the student's interest, increase motivation, and expand the capacity to learn using auditory, visual, and tactile modalities. This new teaching "aide" will prove to be affordable and indispensable addition to the Special Education classroom.

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Appendix 1

Main Computer Program Menus and Sub-Menus Used While Operating Miss STIM

MAIN MENU

1) Load Student Disk
2) Review Student Disk
3) Review Course Catalog
4) Check Out Equipment
5) Systems Utilities
6) Shut Down System

SUB-MENUS

1) Load Student Disk
1)List Lessons Completed
2) Continue Last Lesson
3) Begin Next Lesson
4) Repeat a Previous Lesson
5) Select a New Course/Lesson
6) Return to Main Menu

2) Review Student Disk
1) List Lessons Completed
2) Review Responses for a Lesson
3) Review a Lesson
4) Stimulate a Lesson
5) Return to Main Menu

3) Review Course Catalog
1) Review Course Titles
2) Read Course Summary
3) List of Prerequisite
4) Return to Main Menu

4) Check Out Equipment
1) Video Disc Players
2) Video Cassette Recorder
3) STIM Response Unit
4) Disk Drive A
5) Disk Drive B
6) Printer
7) STIM Control Unit
8) Return to Main Menu

5) Systems Utilities
1) Prepare New Student Disk
2) Validate Student Disk
3) Print Student Summary File
4) Print Student Lesson Review
5) Return to Main Menu

6)Shut Down System
1) Rewind Video Cassette
2) Take Out Video Discs
3) Take Out Program Disc
4) Take Out Student Disc
5) Take Out Video Cassette
6) Switch Off System
7) Return to Main Menu

Appendix 2

October 1985 Schedule of Stimware Productions

Special Education Series

Title: "Elementary Survival Skills"
A 12-chapter interactive Stimware course tutoring the minimum skills desired in severely communications handicapped children for individual and group functions in a school environment. Scheduled release Sept. 1986.

Title: "Elementary Communication"
Addresses serve communications handicaps in the very young (autistic, etc.) by stimulating spoken, written, signed and/or electronically typed expression. Scheduled release Dec. 1986.

Title: "Elementary Signing"
Basic tutor in American Sign Language for the novice. Live camera and dual monitor techniques allows the student direct and instant comparison of his signing with tutor's sample. Scheduled release March 1987.

Title: "Elementary Learning"
A course in learning techniques for the Learning Handicapped. Evaluate student's problem, recommends learning approaches and provides interactive instruction. Scheduled release May 1987.

Therapeutic Series

Title: "Speech Therapy"
Starts with basic speech formation. Steps through progressive exercises where patient can follow therapist while observing self on monitor. Presents A/V replay comparisons. Scheduled release Jan. 1987.

Title: "Memory Builder"
One-on-one interactive course in retention development and memory restoration. For the brain-damaged patient and for general use, where needed. Scheduled release June 1987.

Employment Series

Title: "Job Tutor for the Handicapped"
Confidence-building interactive set of analytical chapters that prepare the handicapped for gainful employment. Tutors team and individual performance, compensation, taxation, etc., etc. Scheduled release April 1987.

Title: "Employment Tutor"
Unemployment Office Tutor in job-hunting skills (attitude, how to apply, interviewing). Analyzes individuals talents and suggests directions. Includes basic retraining instruction. Scheduled release July 1987. Subject to change without notice.

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